Under Armor Auxiliary Power Unit

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In May of 1993, the Mounted Warfighting Battlespace Lab (MWBL), Fort Knox, Ky., at the direction of then U.S. Army Armor Center Commander, Major General Paul Funk, led a coordinated effort to determine the levels of technology available to produce an under armor auxiliary power unit (UAAPU), conduct a field demonstration of that technology, and report on the results. The intent of the project was to determine if there could be any value in integrating UAAPU into the mounted force.

The M1 Abrams force is not equipped with auxiliary power units. When the vehicle is at rest, such as in defensive positions, the main engine is normally shut down while the electrical systems must remain in a power-up state, and the only source for this power is the vehicle batteries. Since the electrical systems will drain batteries quickly, thus endangering crews by failing to achieve main engine start and power loss, there is a strong need for on-board power generation.

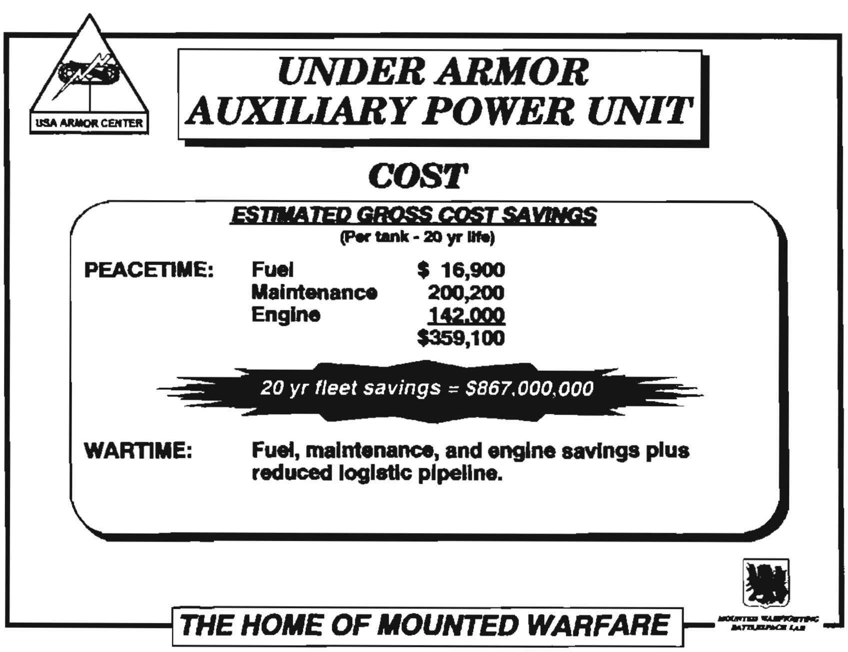
The MWBL sent out an initial request for information to the civilian business community in June 1993 to canvass for their input on UAAPU technology. Four industries have since invested time, effort, and financial resources, each producing a UAAPU prototype for demonstration.

The basic decision (made early in the program) regarding integration was that various corporations would be offered the opportunity to place their UAAPUs in the chassis of demonstration M1A1s, and government offices (Test and Evaluation Coordination Office (TECO), Ft. Knox and PM-Abrams) would design and approve the interfaces of those systems into the vehicle. Three ideals guided this government integration:

- All integrations would be similar to the maximum extent possible. This meant that such things as fuel supply would be from the vehicle's rear fuel tanks, bleed air would be introduced to the NBC system through the existing ducting, etc.

- The integration would utilize existing MILSTANDARD materials to the maximum extent possible, and specifically items which were already installed on the M1A1 tank. This was successful to the extent that only four items are not part of the tank — NICAD batteries, NICAD battery connectors (both of which are on all Army and other types of aircraft), the fuel meters which gather data on consumption and the flexible metal tubing utilized to duct bleed air to the NBC system. Such items as fuel lines and wiring harnesses are constructed of the same materials and in the same manner as those on the engine of the M1A1.

- The integration would not intrude into the operating envelope of the system. This means that all power into the vehicle from batteries and UAAPU would be through the existing battery negative and positive buss bars. This meant that the existing charging system regulators and safety features continue to be utilized. All signals to control the UAAPUs were taken from the test jack (TJ) on the hull network box. Due the configuration of U.S. Army test equipment (STE-ICE and DSETS), test jacks are included on major network boxes. When a signal is generated inside a network box to do something ("turn on NBC," etc.) that signal goes to two jacks, the one



connected to the components concerned and to the test jack. In this manner, all signals necessary to interface the controls of the UAAPU were obtained with no changes to internal operations or configurations of network boxes or software.

With the above considerations in mind, the specific interface requirements for the government equipment to each UAAPU (electrical connectors, fuel connectors, etc.) were approved and published to the UAAPU demonstrations. Each demonstrator provided drawings of modifications needed to the vehicle chassis to TECO which recommended adoption, possible re-design, or non-adoption to PM-Abrams. PM-Abrams was the final approval/disapproval authority for these modifications. Upon approval, the modifications were taken to Directorate of Logistics, Ft. Knox, for fabrication on the vehicle. A major portion of this integration effort is to install the following instrumentation:

- Fuel Consumption Meters - Meters were installed on both the main engine and the UAAPUs for the purpose of capturing specific fuel consumption. These meters measure consumption and not rate.
- Master Battery Hour Meters - These meters measure total hours the vehicle electrical system is in operation.
- UAAPU Hour Meters - These meters measure total operational hours for the UAAPUs.

Two additional meters already organic to the system will be recording main engine run hours (hull network box meter) and kilometers driven (odometer). Additional meters (main engine fuel and master battery hour meters) will be installed on baseline tanks not equipped with UAAPU, but participating in the same training exercises. With these data points, a fairly accurate mission profile of these systems (in a training base environment) will be documented. Additional data to be gathered periodically:

- UAAPU running noise.
- UAAPU and main engine charging rates in volts DC, amperes and "online noise" through kilohertz measurements.
- Temperatures in UAAPU compartment and supporting structures.
- Start curves of volts, amperes and kilohertz for UAAPU and main engine.

These data points, when combined with MANPRINT data points and thermal/noise signature recording, will provide a very comprehensive profile of the operation of UAAPUs, versus use of the main engine as a battery charger.

Currently, the MWBL is looking to continue experimentation with the UAAPU application to the combined arms digitized force, thus allowing the entire force the same advantages as so far seen by the M1 Abrams. To this end, a Combined Arms Under Armor Auxiliary Power Unit Conference was held at Fort Knox in March 1994. Attending this conference were representatives from the other battle labs, CASCOM, TARDEC, and program managers from various mobile platforms. This meeting resulted in commitment from all offices to work together to obtain a combined arms under armor auxiliary power unit.

The key to the program is simple: Total digitization cannot be achieved without vehicle on board power generation. Through the initiative taken by the Mounted Warfighting Battlespace Lab, this goal will be met in the near future.

The TRADOC System Manager for the AGS Comments on "The AGS in Low-Intensity Conflict"

In response to Captain Womack's article on the XM8 Armored Gun System (AGS) in Low-Intensity Conflicts (Mar-Apr 94), I would like to clarify the philosophy behind the design of the AGS.

The XM8 AGS was designed to be significantly more lethal, sustainable, survivable, and maintainable than the M551A1 Sheridan. Our primary requirement influencing all of these designs was that of transportability. The AGS must be able to be deployed via USAF tactical and strategic lift aircraft (C130, C141, C17, C5A) using the same Low Velocity Air Drop and Roll-on/Roll-off equipment and techniques that are employed for the M551A1 Sheridan.

This transportability requirement placed very severe constraints on the overall size, and more importantly, the weight of the base AGS vehicle. Within this weight/size constraint, it was just not possible to incorporate the Commander's Independent Thermal Viewer. Other items that were considered for the AGS but deleted because of weight were an auxiliary power unit, an integral bustle rack, and an individual vehicle tow bar.

As currently configured, the AGS does incorporate a 12-round per minute autoloader, three levels of modular armor designed to meet a variety of threats, dual net communication capability, an external phone for the infantry, a digitized fire control computer storing ballistic solutions for the entire family of 105-mm tank ammunition, a 1553 data bus, and an engine that, in addition to being able to operate on a wide range of diesel-type fuels, can be rolled out of the hull for maintenance in under 10 minutes.

Although the AGS doesn't have all the "bells and whistles" we would like it to have, it will provide the Army's early entry forces with significant firepower and crew protection within a system package that is easily deployable, maintainable, and sustainable.

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The first AGS has rolled out of the factory, one of six to be built for further testing by the Army. See back cover. — Ed.